ON CERTAIN CATERPILLAR HOMOLOGIES.

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A recent paper by Stanley B. Fracker[1] raises some interesting questions as to the interpretation of the caterpillar setæ. He takes the prothorax as a typical segment, having the largest number of setæ of any simple segment, names its setæ, and then, assuming the setæ of the following segments are strictly homologous, so far as they go, applies to them the same names. My belief is that the correspondence is partial, and so far as the prothorax is concerned confined to a couple of the mid-ventral, and possibly the mid-dorsal setæ. In the following discussion the thoracic setæ will be referred to by the Greek letters applied to them by Fracker, the abdominals, by the numerical system now in use, derived, so far as the principal setæ are concerned, from Wilhelm Müller.

The abdominal setæ consist of i, ii, iii and iii *a*, which lie above the spiracle, iv and v, between the spiracle and the subventral fold; vi between this fold and fold *psi*, appearing only after the first moult, vii on the outer side of the leg-base, typically of three setæ, and viii on the inner side, near the mid-ventral line; besides these ix, subventrally, and x subdorsally are minute setæ, lying close to the incisure and touching the posterior curve of the preceding segment; presumably, like our own tendon-organs, they serve to report to the caterpillar its own position.

In the Hepialidæ there is a slight modification, the three setæ nearest the spiracle, behind and below, are in an oblique row, and placed high up;[2] I have assumed that these are iv, v and vi, moved up and back, as they have in Incurvaria.[3] Fracker assumes that the two lower are iv and v (kappa and eta), that the upper is a new subprimary (theta), and that the usual subprimary vi (mu) is absent. In the first stage, as figured by Dyar, there are only two setæ very slightly higher than the two lower of the row in the last stage. The

[1] The Classification of Lepidopterous Larvæ; Illinois Biological Monographs: II, 1; 1915, Urbana, Ill.

[2] Ann. Ent. Soc. Am., III, pl. 12, fig. 33.

[3] *L. c.*, fig. 34.

approximate correspondence in position of the two primaries of the first stage (which we agree to be iv and v) with the two lower of the later stages, leads Fracker to believe them the same; from the same data however I concluded that iv and v, which are very high even in the first stage, had moved considerably farther, and that vi had appeared as usual below them. The problem could only be settled by a full study of the muscular system, and determination if the organs of that part of the body have moved up, or by definitely locating the subventral fold, which runs in the Frenatæ between v and vi. The first is impossible in the complete lack of material, but a specimen before me shows most of the dorso-ventral muscles in the last stage (see figure). The two folds (the subventral and *psi*) are both formed by intermediate insertions of the retractor muscles of the proleg, etc.; we find in *Hepialus* the most dorsal of these insertions, defining the subventral fold, are immediately below the spiracle; and far above, not below, the seta which I interpret as vi. A second insertion appears below vi, which I interpret as marking the fold *psi*. I then rest in my former opinion that the three setæ are iv, v and vi, not a new subprimary, iv and v.

Next in order is the homology of the meso- and meta-thorax with the abdomen. I think we are agreed that i is alpha, ii is beta, x is gamma (four setæ on the thorax,[4] both in Jugatæ and Frenatæ); vii *a* and *b* are nu and pi, vii *c* is tau, viii is sigma and ix is omega. The difference then is in Dr. Fracker's assumption that the numbering used was intended to imply homotypy, which was the case only with the ventrals and small primaries; and in the lateral region, comprising iii, iii *a*, iv, v and vi on the abdomen, and epsilon, rho, kappa, theta and eta (delta, rho, kappa, theta, and epsilon in the Jugatæ) of

[4] It has been a puzzle to me for some time why the mesothorax has three setæ in group X, while the metathorax has four. Y. H. Tsou, in the Trans. Amer. Micr. Soc., XXXIII, 223, has recently given a satisfactory explanation, namely that one of the normal four setæ has moved across the incisure to the prothorax, where it has been generally overlooked or treated as a secondary prothoracic seta. In other points I am inclined to disagree with Mr. Tsou for the same reasons as with Mr. Fracker. And why should two papers from the same laboratory on the same subject worked out at the same time use entirely different nomenclatures for the same structures! One paper must be translated before it can be compared with the other, and then we find that in other features they are often in agreement.

the thorax. Again I believe, though this time mainly without evidence on either side, that the setæ of Jugatæ and Frenatæ are homologous, but differ a little in position. So I take the anterior lateral, epsilon, of the Jugatæ, to be eta of the Frenatæ, and delta of the Jugatæ to be epsilon of the Frenatæ.

As to homologies with the abdomen so far as number of setæ goes the comparison is close, only that there are two subprimaries on the thorax. Unfortunately the presence and location of the wing and spiracular rudiments makes the homology impossible. Above the spiracle, on the abdomen we have only iii and iii*a*, while above the wing-rudiment, which must be well above the spiracular level, we have all except eta of the Frenatæ on the thorax, and that is far above the actual thoracic spiracular rudiment, which lies on the level of vi (pi). Eta is anterior, and free from the wing, but there can hardly have been extensive migration of kappa and theta as they are closely associated (above) with the wing-base, especially the primary kappa. We have then epsilon, rho, kappa, theta and possibly eta (if it is epsilon of the Jugatæ) to compare with the two setæ iii and iii *a* of the abdomen. Under the conditions any comparison is a guess, and Fracker's one that iii *a* is epsilon, and iii is rho, is as likely as any. Below the spiracle, we have nothing to represent iv, v and vi, as

SUMMARY.

Meso-, and Meta-thorax.			Abdomen.		
Forbes (after Dyar).	Fracker Jugatæ.	Fracker Frenatæ.	Forbes (after Dyar).	Fracker Jugatæ.	Fracker Frenatæ.
i *a*	alpha	alpha	i	alpha	alpha
i *b*	beta	beta	ii	beta	beta
x *a*, x *b*, x *c*, x *d*	gamma	gamma	x	gamma	gamma
Level of dorso-ventral muscles					
ii *a*	delta	epsilon ?	iii *a*	epsilon	epsilon
ii *b*	rho	rho ?	iii	rho	rho
iii	theta	theta	absent		
iv	kappa	kappa	absent		
v	(epsilon ?)	eta	absent		
Level of wings and spiracles					
absent			iv	theta	kappa
absent			v	kappa	eta
absent			vi	eta	mu
vii (vi Dyar)	nu, pi	nu, pi	vii *a*, vii *b*	nu, pi	nu, pi
setæ on coxa			vii *c*	tau	tau
viii	sigma	sigma	viii	sigma	sigma
ix	tau	omega	ix	Tau group	omega

eta is so far forward as to be nearly out of the question; in fact if the position of the spiracular rudiment means anything, the subventral region is practically undeveloped in the caterpillar meso- and meta-thorax.

Coming to the prothorax I can only say that I agree with Fracker as to the ventral part, and again can see no proof of homologies in the lateral and dorsal part. The muscles imply here as large an over-development of the lateral region, as it was under-developed in the rest of the thorax, but hardly prove it. The spiracle has risen again to its abdominal level.

It seems probable that these differentiations of seta-pattern on thorax, prothorax, and abdomen, are much older than the seta-plan of either one, itself. For instance in the Trichoptera the seta-plan has not fully taken the Lepidopterous pattern, especially on the thorax, but the three types of arrangement already exist.

A few other points may be noted at this point in connection with Fracker's paper.

The bisetose prespiracular wart on prothorax in the Pyralidina, combined with the typical micro-seta-pattern on the abdomen and prolegs, is diagnostic, and fills a serious need in the definition of the group. I do not think the character has been noted before.

Many of the Cosmopterygid-Œcophorid series are not leaf-feeders, as stated by Fracker in his family table; they may bore in seeds, stems, and even thorns, several are scavengers, and one carnivorous. This leaves the Cossidæ uncomfortably close to the Gelechiidæ; of course our species are much larger when full grown: iii of the abdomen is duplicated in Cossus, but the character may not be general.

The uniordinal crochets of the Dioptidæ are a surprise to me. The trifid venation of the imago, and according to Packard the pupal characters, associate this family with the Geometridæ; they are however also close to the Pericopidæ and Hyssidæ in the rest of their venation, almost intergrading with the South American Pericopidæ, and may be more closely related to them than we have supposed. The structures at the base of the abdomen ought to be investigated, as they are characteristic, and of one type in the Pericopidæ, Lymantriidæ, Arctiidæ, some Noctuidæ, etc., while in the Bombycid series a wholly different structure appears, and in the Geometridæ, as noted by Prout, a third. The Thyatiridæ seem to cling still to the Geometridæ.

Apatelodes, and other Eupterotidæ, has well marked, though small warts, as also I believe have a few primitive exotic Lasiocampidæ; they differ so far as I know from practically all the following families by their abundant and conspicuous secondary hair. They really come very close to the Bombycidæ, which also have warts dominated by secondary hair, and widespread prolegs, with regular biordinal hooks, but in the familiar *B. mori* at least the hair is much more reduced.

Sthenopis shows the characters of the Hepialidæ as given by Fracker.

I believe that the true Heliodinidæ (*e. g., Lithariapteryx*) are re-

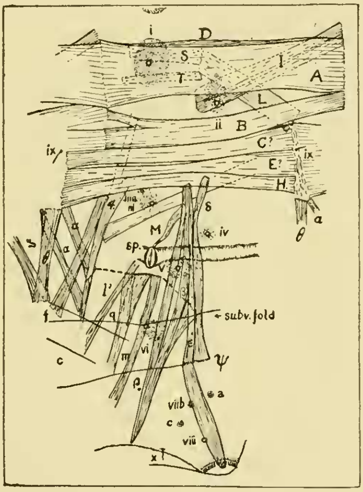

Fig. 1. Lateral and dorsal muscles of larva of *Hepialus humuli.* The drawing is from a prepared skin and to be trusted only for what it shows. The muscles are labelled according to Lyonet's system, the tubercles according to what I believe to be their homologies. The drawing is mainly from the fourth abdominal segment. Note presence of *S* and *T,* migration forward, rather than back, of lower dorsal longitudinal fibers, and position of upper ends of *m* and *q,* intermediate insertion of beta, and lower end of uppermost fiber of alpha. *subv. f.* Subventral fold—marked by the broken line. *sp.* Spiracle. viii is seen by transparency.

lated more or less closely to the Yponomeutidæ, while the Heliozelidæ (*Antispila* and *Coptodisca*) are much more primitive forms on another line, connecting perhaps with the Elachistidæ. Their larval characters bear this out, and I suppose "Heliodinidæ" on page 49 will change to Heliozelidæ.

In the Pieridæ (at least in *Pieris rapæ, brassicæ,* and *daplidice*) certain of the most conspicuous setæ are undoubtedly the three upper primaries, as I have proved by breeding the first stages.[1] The crowd of secondary setæ which confuse the picture in the full-grown larva are much fewer in the second stage, appearing gradually stage by stage, and the history of setæ i, ii and iii is continuous; as to iv and v I feel much less certain, but suspect they are the two largest in the subventral region, as they have the same relative position, essentially, in stage one. When so traced the primaries of *Pieris rapæ* may be recognized by their light color, and i and ii by their glandular character.

Dr. Fracker's paper has a bibliography citing most of the articles mentioned above. The typical arrangement of muscles and skinfolds is given in Ann. Ent. Soc. Am., VII, 109, 1914.

NOTES ON ALLECULIDÆ (COLEOPTERA).

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The name of this family was changed by Dr. G. Seidlitz in Erichson's Insekten Deutschlands because the former name was derived from *Cistela,* which was originally used by Geoffroy for an insect of a different family. Following Seidlitz the family Cistelidæ of our Check List becomes the family Alleculidæ of Junk's Catalogus Coleopterorum, constituting part 3, by F. Borchmann.

It is to be regretted that some errors may be detected in this author's work. *Mycetochara horni* Dury, Journ. Cin. Soc. Nat. Hist., XX, 1902, is omitted, *Tedinus angustus* Casey is cited as *angustatus, Prostenus californicus* Horn is cited as from California notwithstanding the remarks of Champion, Casey and Fall, which make it plain that its occurrence in California must have been accidental and its real home is Central America. The treatment of the genus

[1] Psyche, 1909, 69.